The MACROECONOMICS Of ADAPTATION

Climate | Resilience | Europe
SPARCCLE

SPARCCLE-ACCREU-CROSSEU Webinar

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Sectoral adaptation pathways and limits

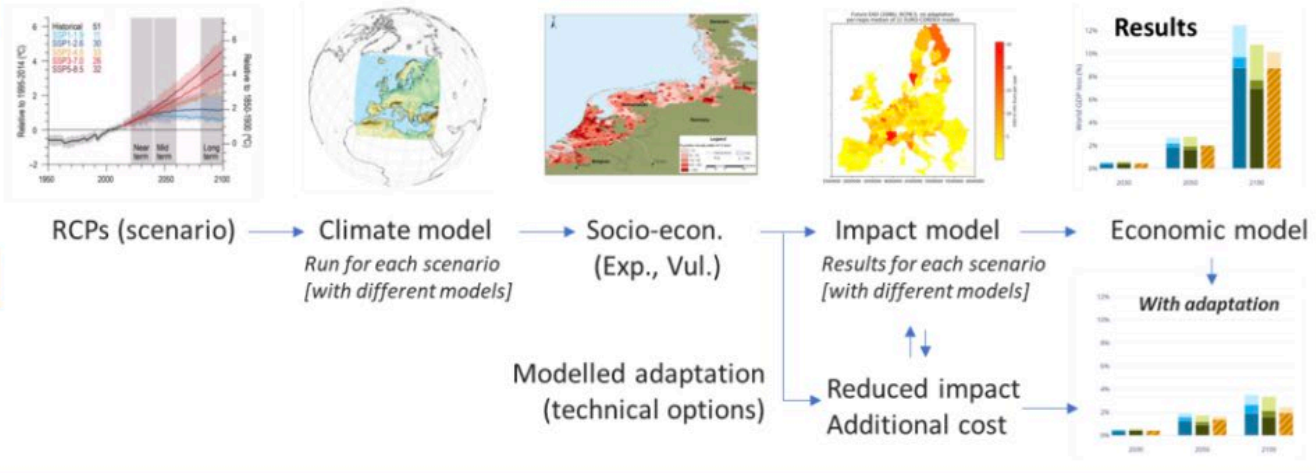
Science and policy approaches regarding adaptation

Science first - impacts

What are the economic costs of climate change in Europe in 2050 and 2100, under different warming scenarios?

Science first - adaptation

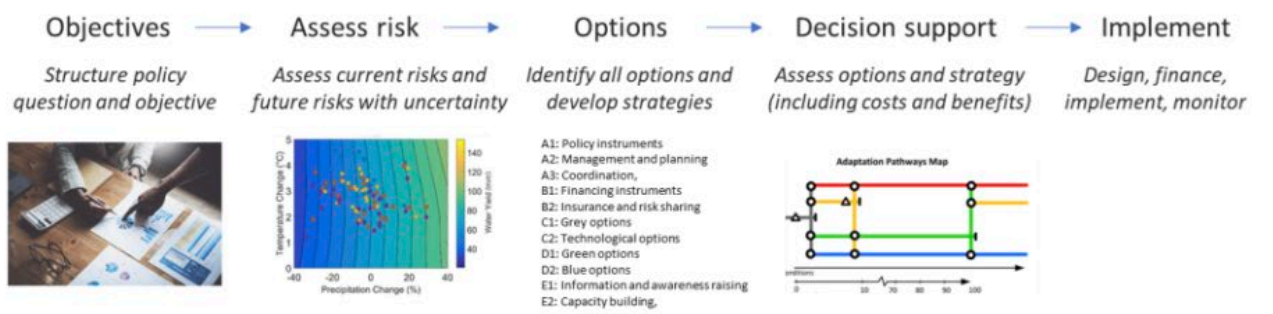
What are the modelled costs and benefits of adaptation in 2050 and 2100, for each of these warming scenarios?



Policy first – adaptation

What robust, cost-effective adaptation strategy can we take?

What are the costs and benefits of adaptation for the next national adaptation plan?



Coupling of physical impacts including extremes into probabilistic climate risk modelling

$$\mathbf{AR}(t) = f(t)\ GDP(t)$$

AR(t): available resources for heat adaptation
$f(t)$: fraction of country's **GDP** devolved to heat adaptation

$$\mathbf{AN}(t) = \sum_{T} r(T)\ E(t,T)$$

AN(t): adaptation needs
$r(T)$: cost of adaptation per unit of exposed people for a given temperature T
$E(t,T)$: people exposed to temperatures T

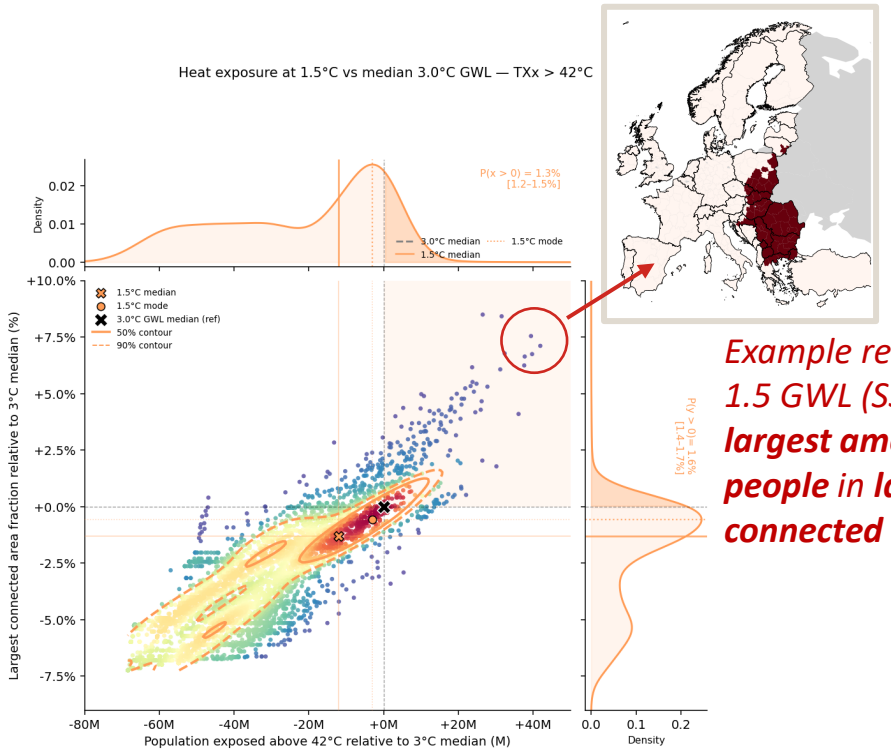
Adaptation Coverage $AC(t) = AR(t)/AN(t)$ Fraction of resources that the countries can cover

Ideally, we want $AC(t) \geq AC_0$ to have ***at least the same heat impacts*** on people as today

$$\frac{f(t)GDP(t)}{f_0 GDP_0} \geq \frac{\sum_T r(T)\ E(t,T)}{\sum_T r(T)\ E_0(T)}$$

Coupling of physical impacts including extremes into probabilistic climate risk modelling

- Focus on **most stressful conditions and patterns**, e.g. realizations affecting many people in neighboring regions/countries
- Extend to **extreme precipitation exposure of assets**, possibly other extremes covered by MESMER
- **Refine adaptation coverage** approach by grounding adaptation costs estimates *r(T)* from D4.1/literature, both for heat and heavy precipitation



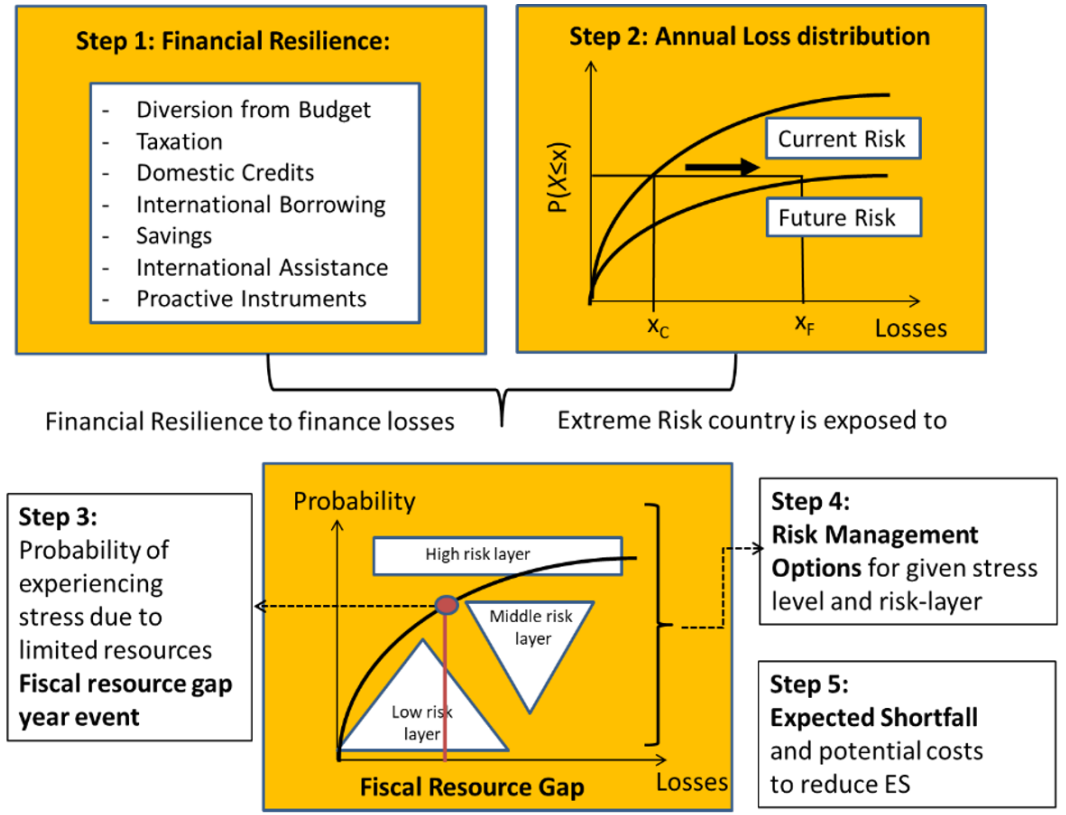
Example realization in 1.5 GWL (SSP3) exposing ***largest amount of people*** *in* ***largest connected area***

Probabilistic physical risks for integrated assessment models

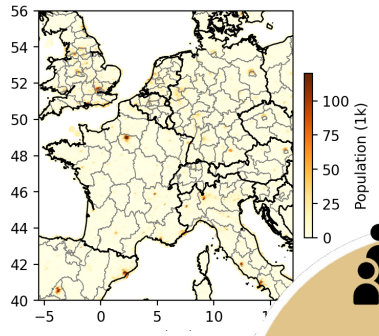
- CatSim estimates the total available financing resources of each European governments to address climate risk, and identifies their expected annual **fiscal gaps**.

- **Milestone MS18**: Preliminary risk layer handover for IAMs (M30). Including a methodological report on the approach adopted as well as results on EU countries fiscal gaps (finished) (Step 3, 5)

- **Update** of financing resources based on empirical analysis of **past disaster events and financing sources** used (Step 1). Update of risk-layers using new fiscal resources identified (based on recommendations of reviewers).

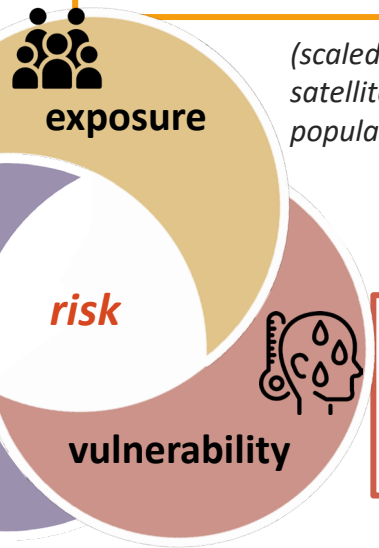


Integration with Climada



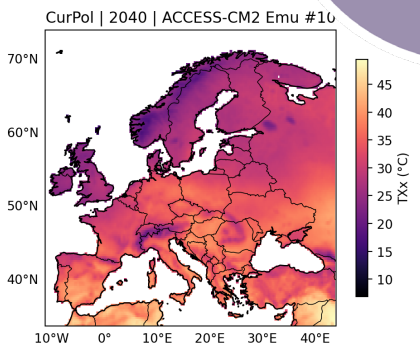
European **population at NUTS2** level

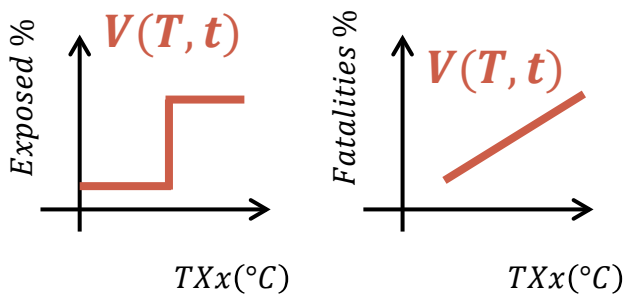
(scaled nightlight satellite images + population census)



Extreme heat (TXx), **Extreme precipitation** (Rx1day)

Impact function that depends on **socioeconomic factors**





Hazard Emulations from MESMER

- TXx, Rx1day (2.5 degree resolution)
- Stress-Test Scenarios

Exposure Projections

- Population trends for different socioeconomic scenarios
- Physical Assets for extreme precipitation

Vulnerability

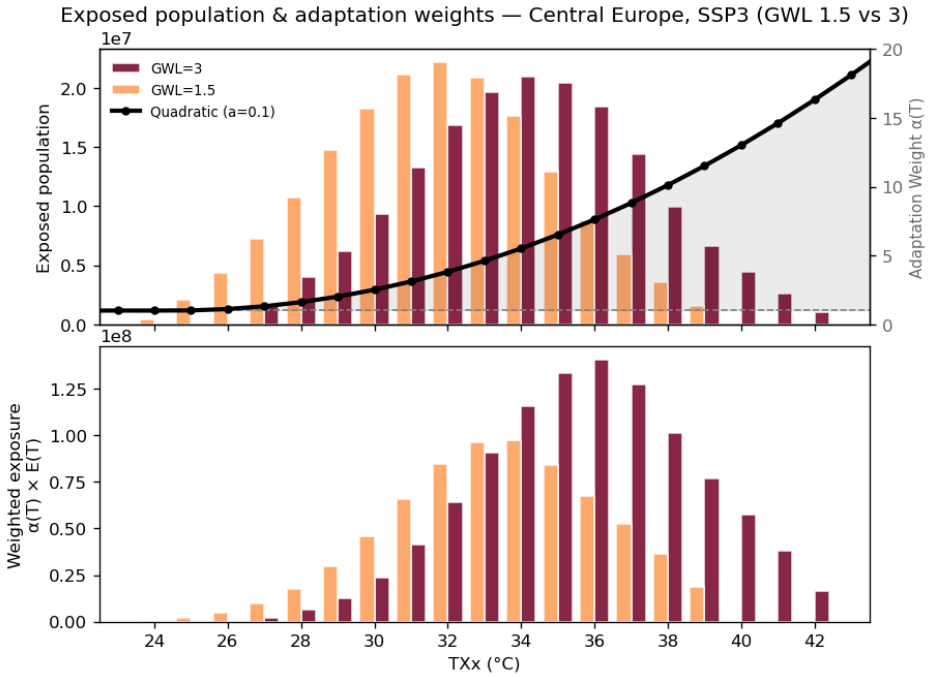
- People/Assets *exposed* to Hazard
- Fatalities vs TXx
- Economic Damages vs Rx1day

➢ ***Adaptation Coverage***

WP4: Climate Risk over Europe - Adaptation Coverage

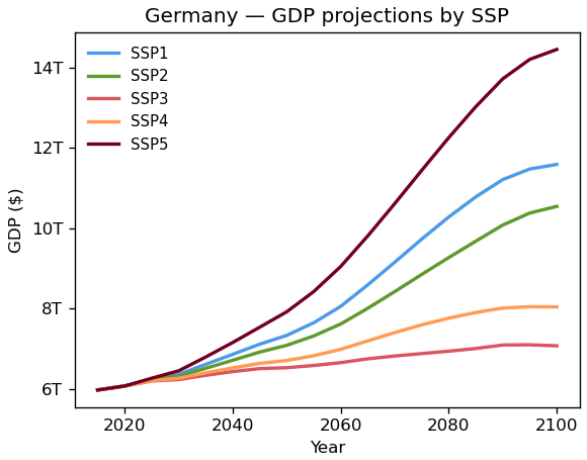
The capacity of European countries to **protect people from extreme heat** depends on

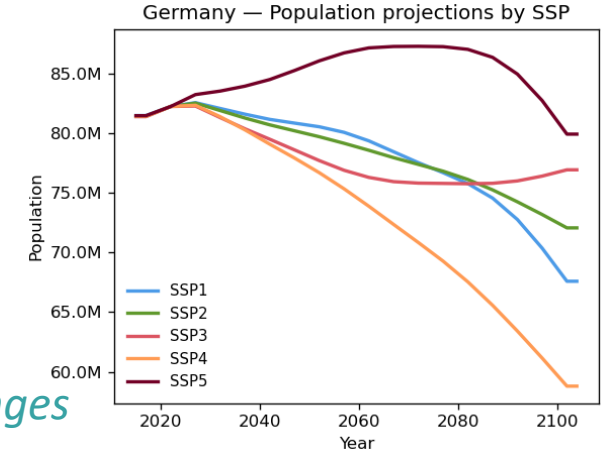
Different pace of warming across Europe



Socioeconomic conditions

➢ *National economy*





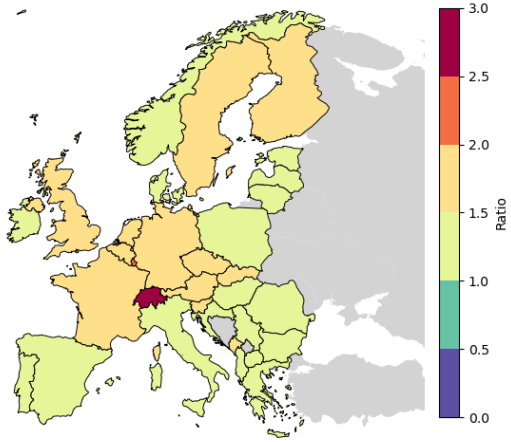
➢ *Population changes*

➢ *Adaptation costs*

Cost scaling function: how much more expensive it is to adapt to higher temperatures

Drivers of Adaptation Coverage

AN



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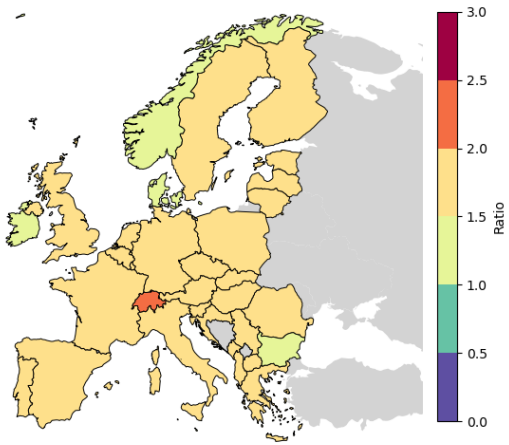

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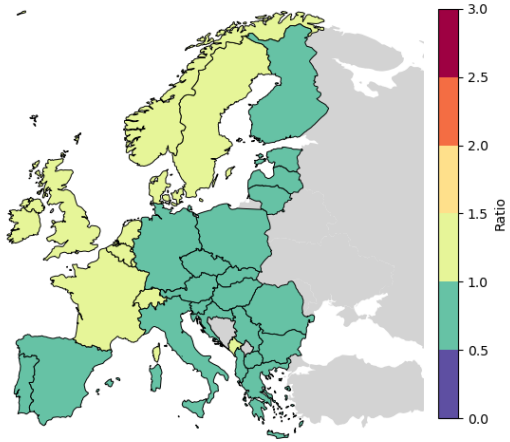
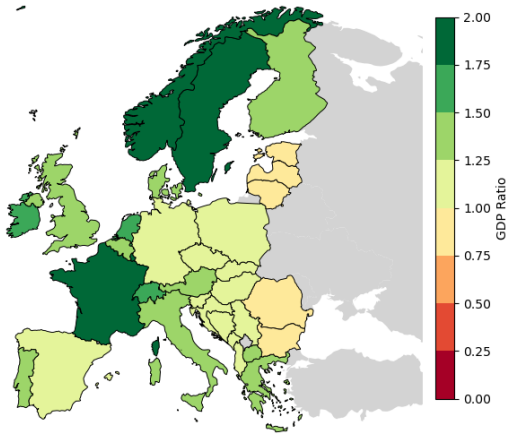


➢ *TXx distribution shift due to climate change*

➢ *Population Changes*

Example:
SSP3
3°C/1.5°C

AR



➢ *GDP Change*

Minimum investment changes** wrt today to **keep same coverage as today

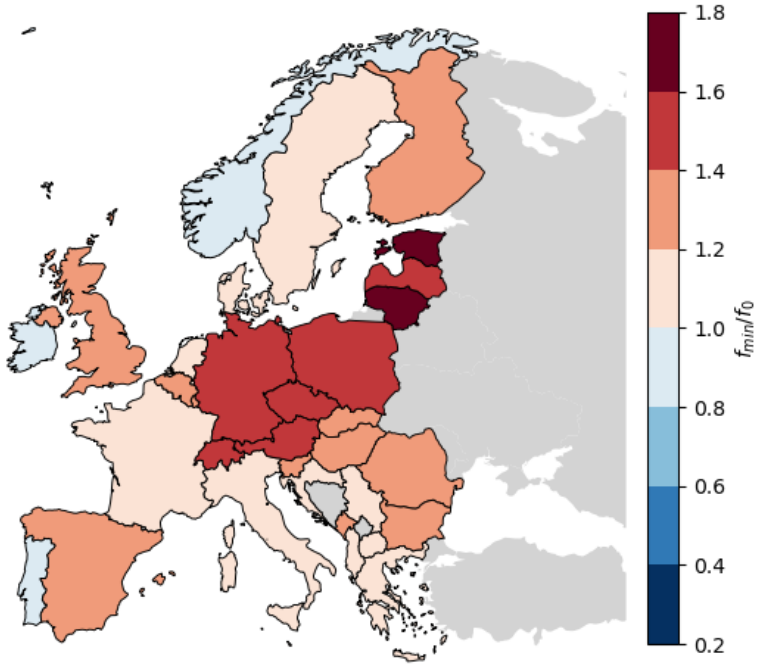
$$f_{min}: AC(t) = AC(t_0)$$

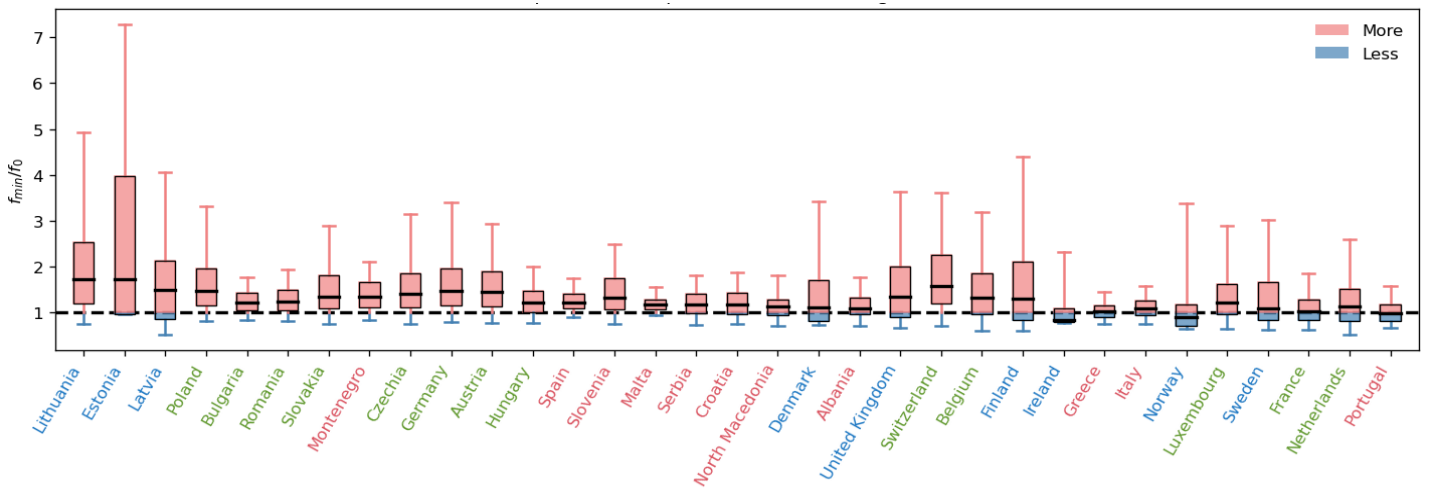
$$\frac{f_{min}(t)}{f_0} = \frac{AN(t)}{AN_0} / \frac{GDP(t)}{GDP_0}$$

Different challenges for Adaptation

Minimum Required Investment Changes

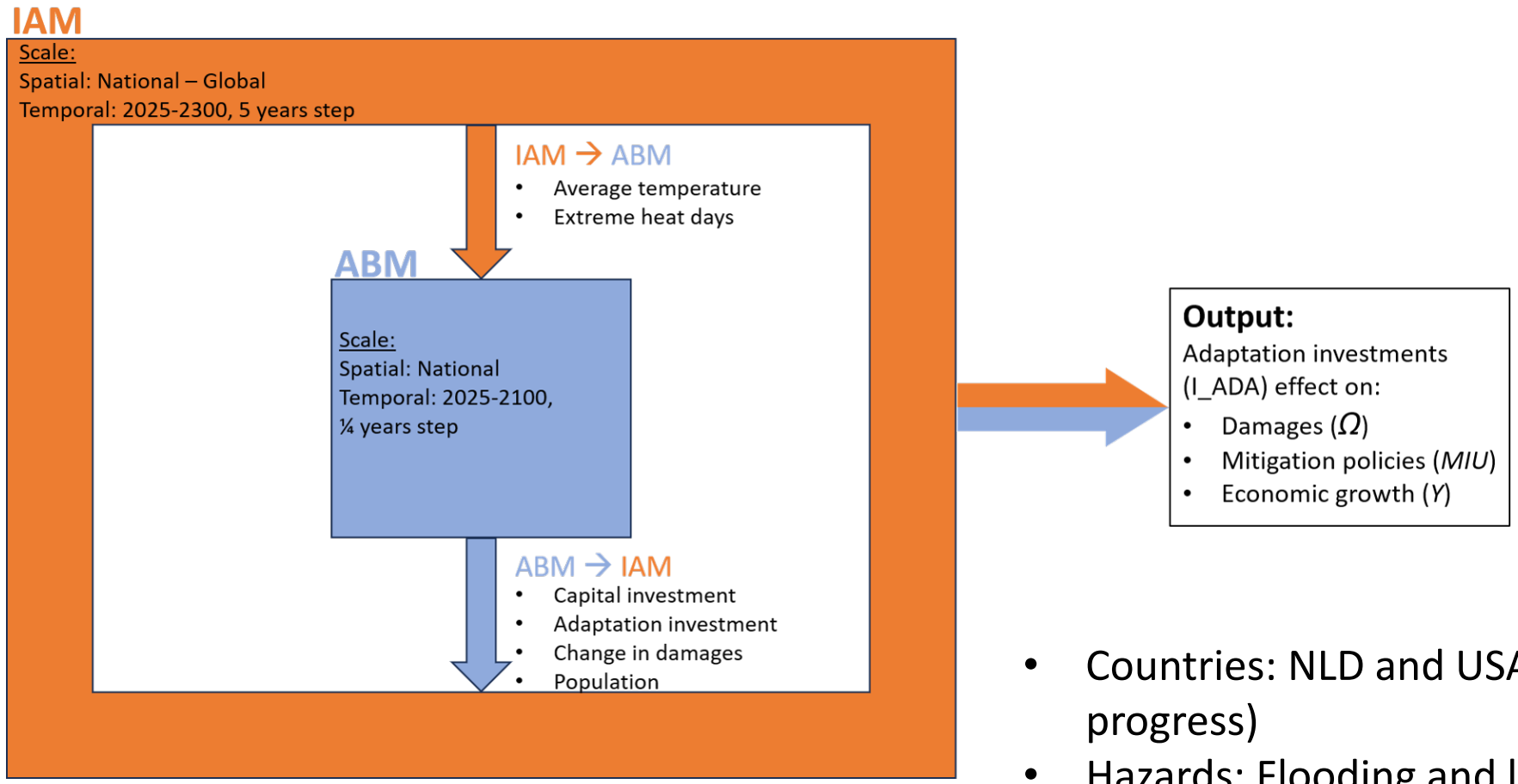
$$f_{min}: AC(t) = AC(t_0)$$





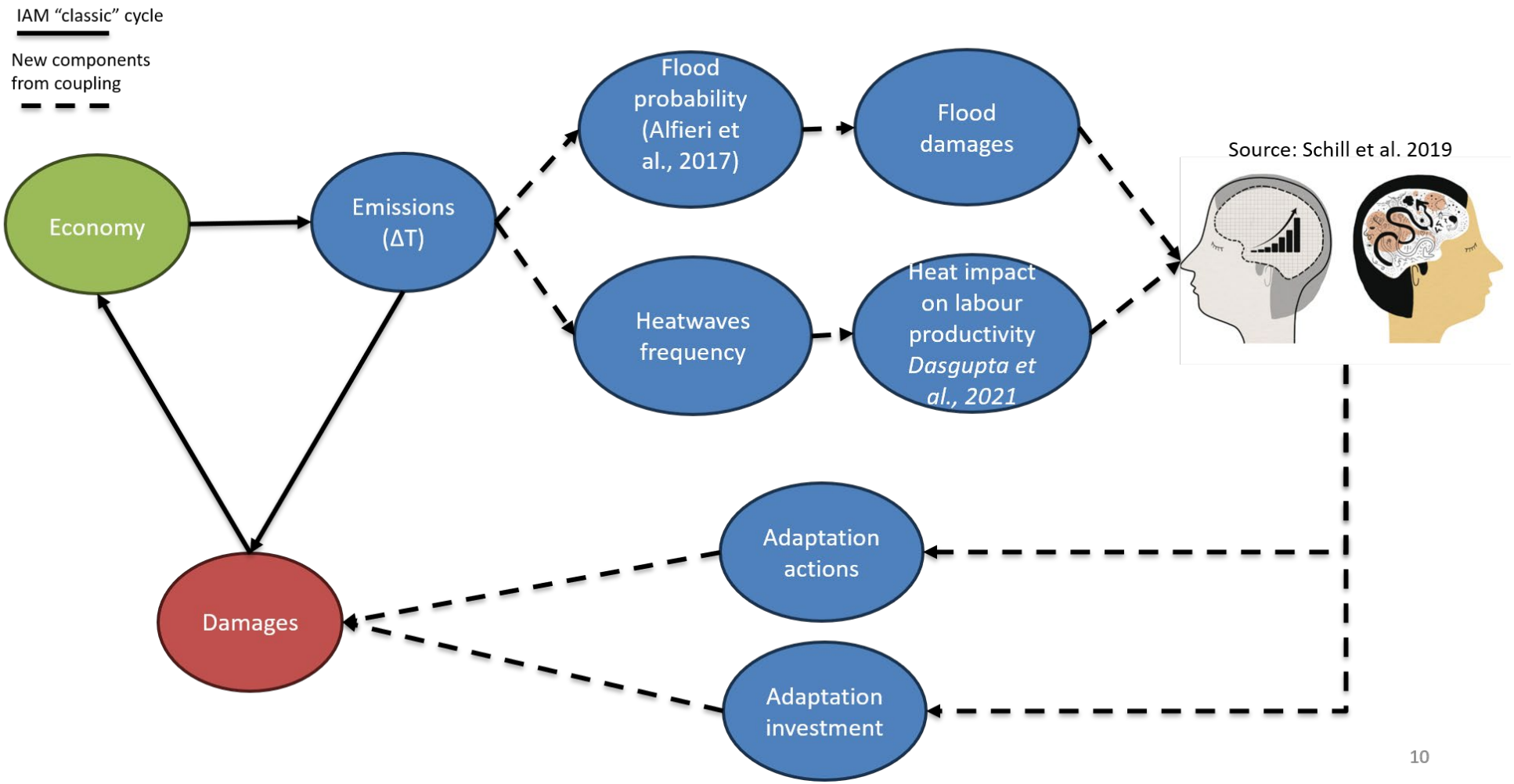
- **Central-Western Europe:** Largest relative challenge; big population, large temperature shifts, low baseline hard to maintain
- **Southern Europe:** Smaller shift; shrinking population, but higher baseline stress already
- **Northern Europe:** Large temperature changes but low overall values, growing population, stronger economies, low baseline

WP5: Modelling Adaptation – Coupling scheme

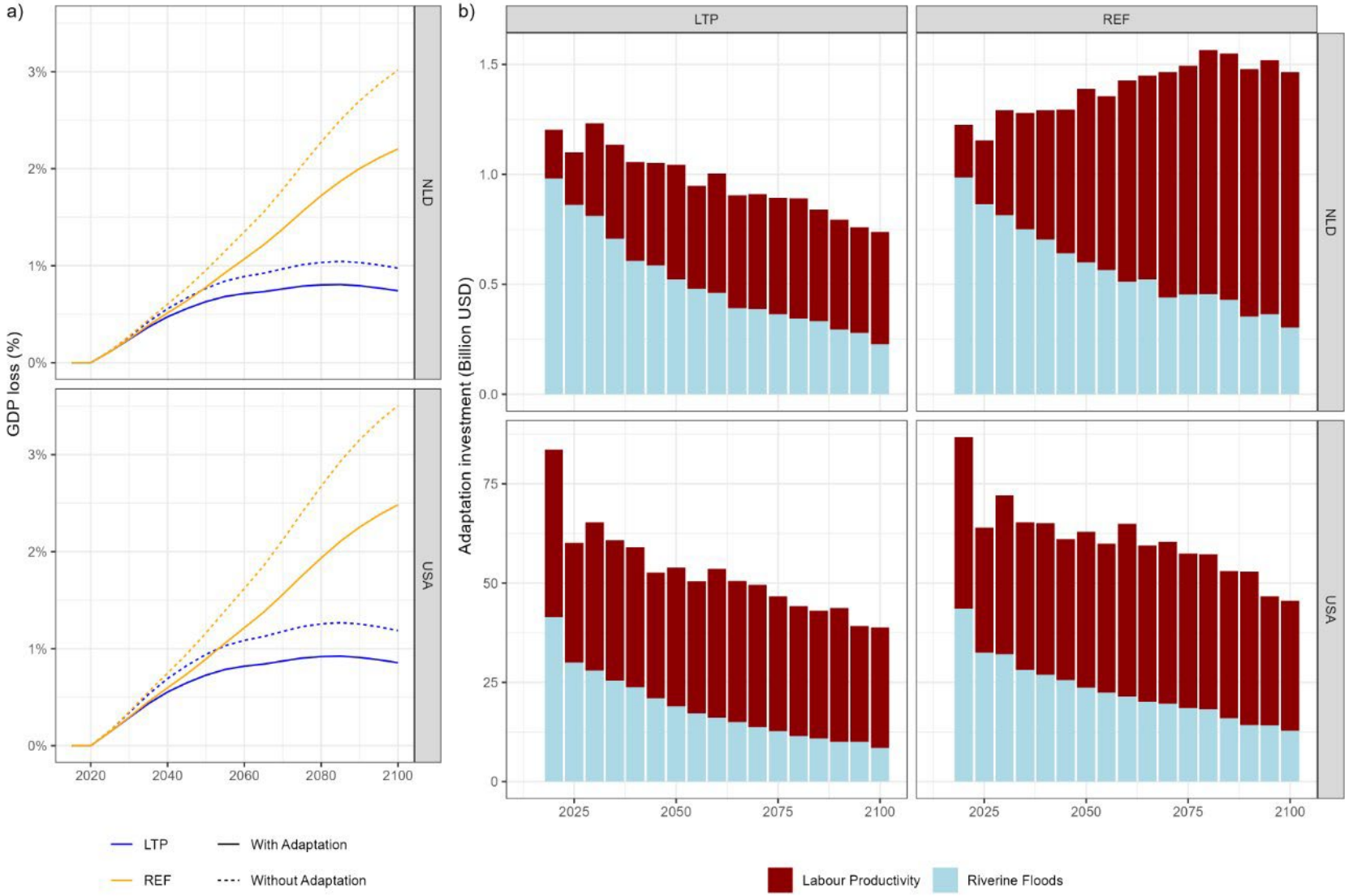


- Countries: NLD and USA (whole **EU** work in progress)
- Hazards: Flooding and labour productivity

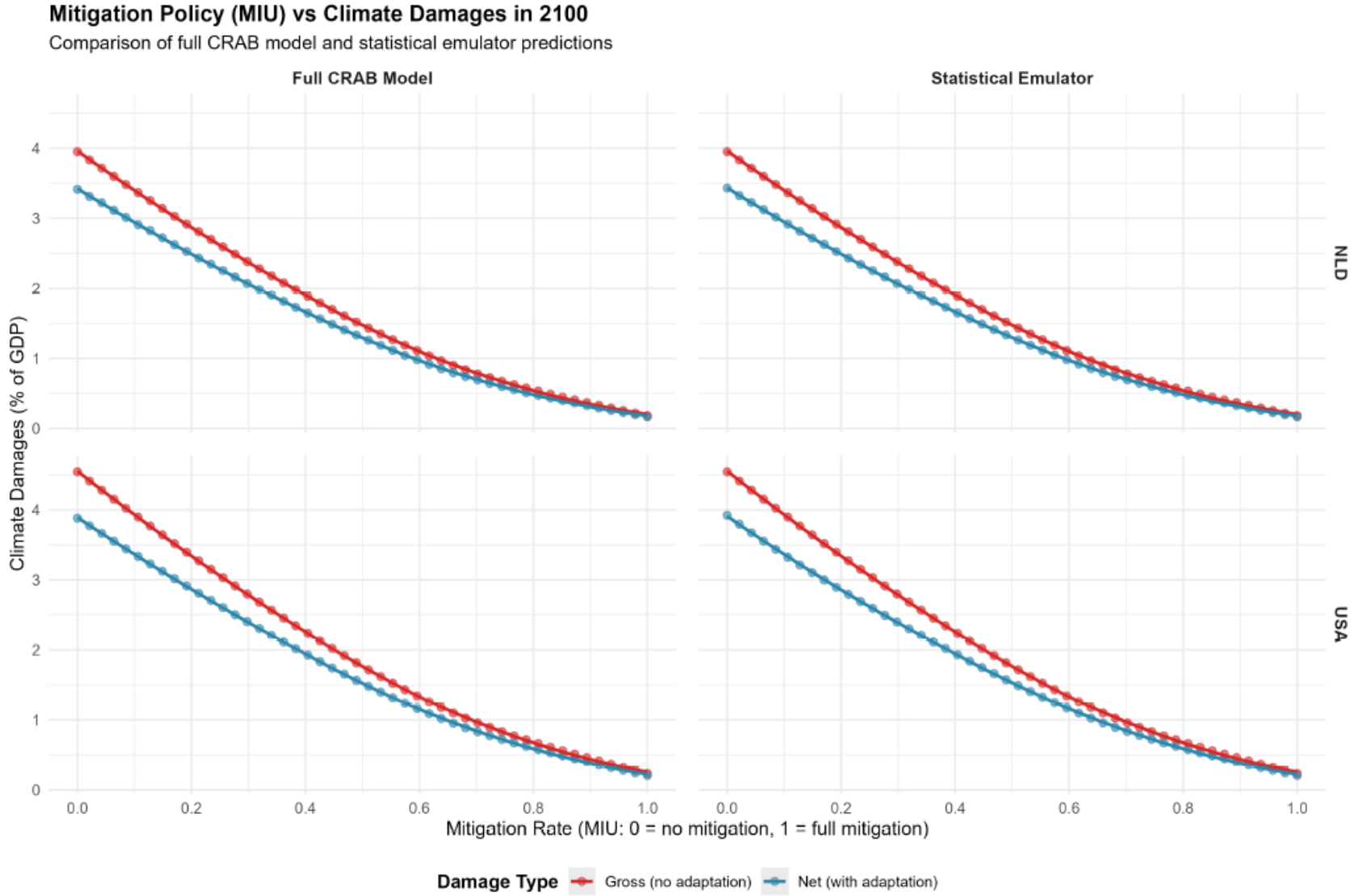
Modelling Adaptation – Adaptation via coupling



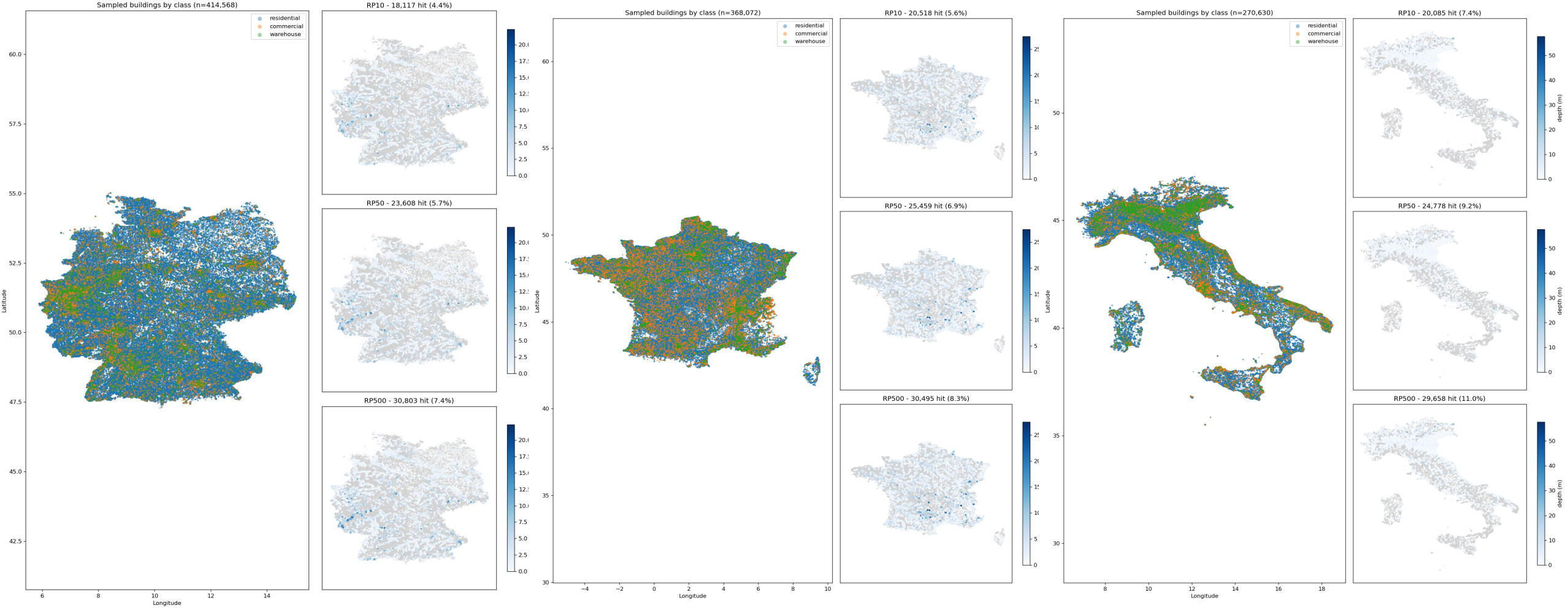
Modelling Adaptation - Results



Modelling Adaptation – Emulator



Modelling Adaptation – EU exposure calibration



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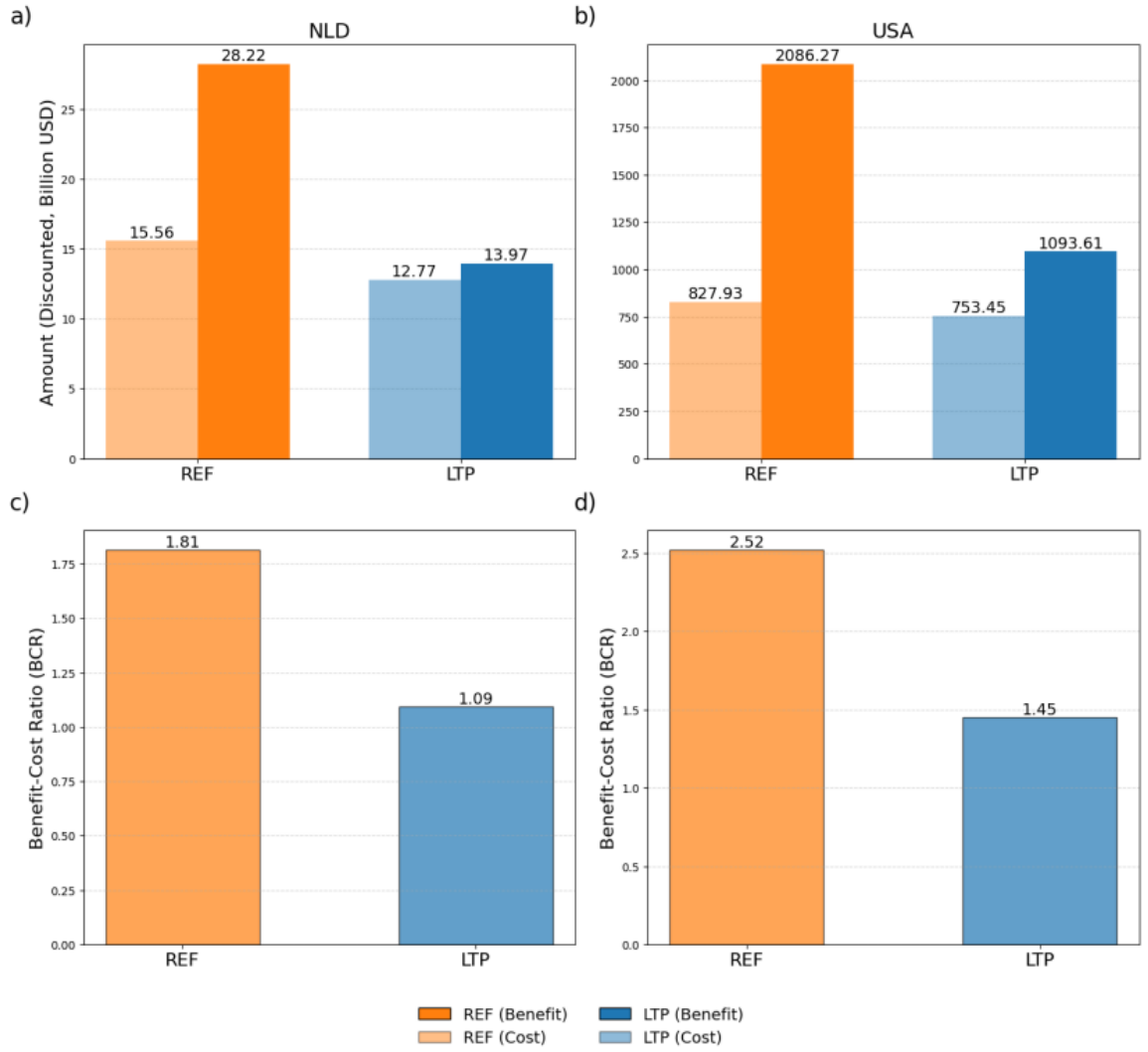
Results for Adaptation to head/floods

- Generally BCR>1
- Improved long-term growth potential
- Lower under Net-Zero LTP scenarios, but still positive



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Thank you!